Earth History Field Trip
for High School Science Teachers
Cave in Rock, Illinois, April 17, 1948

Sponsored by State Geological Survey
M. M. Leighton, Chief
Gilbert O. Raasch, Conference Director
Principal Wm. H. Riggs, Conference Host

General Instructions:

1. Please be prepared to leave promptly at 9:00 a.m.

2. Cars will assemble at Cave in Rock Community High School.

3. Participants will provide themselves with lunches before starting.

4. At scheduled stops, please assemble promptly near leader to hear his discussion before scattering for individual examination of points of interest; also please be prompt to leave upon signal. This is especially desirable if the group is large.

Instructions for Car Drivers:

To expedite the trip and for safety, please

1. Identify your car by attaching one of the tags provided.
2. Have your car in line before the trip starts.
3. Follow carefully and keep fairly close to the car ahead, with due regard to safety.
4. Keep all gaps in the caravan closed, especially while traveling through the city, in order to prevent other cars from inserting themselves in the caravan or crossing the caravan at intersections.
5. Watch the cars ahead and behind for signals.
6. Keep your place in the caravan as far as possible; do not attempt to pass ahead of any in the caravan unless they drop out of line, nor to gain an advanced position at stops.
7. If for accident or other reason you drop out of line, let those following you proceed, except for such help as may be needed; in case of accident to the rear car of the caravan, signal those ahead.
8. Any car dropping out of line shall take up the rear when rejoining the caravan.
9. When parking in line at stops, draw close to the car ahead; when parking parallel, do not leave unnecessary space between cars.
10. One passenger in each car, preferably sitting beside the driver, should read the itinerary and keep the driver adequately informed with regard to stops, turns, etc.

ITINERARY

0.0 Caravan assembles at base of hill, below the high school and faces West on E-W road.

0.1 Turn right (N) on State Highway No. 1.

1.7 Junction with State Highway No. 146; turn left (W) on No. 146. Quarry in St. Genevieve (Mississippian) Limestone on right.
Note: For next 8 miles road passes through country marked by many small, undrained depressions, many containing small ponds. These depressions are sink holes, caused by sinking of the soil into crevices and cavities developed in the soluble limestone below. Sink holes are marks of cave country.

9.6 Basset School. Turn right (N) on gravel road.

10.1 Outcrop of Renault Limestone (Upper Mississippian) at base of grade. A prominant fault passes close to this point.

11.1 Forks. Go right (E), past cliffs of Tar Springs (Upper Mississippian) Sandstone.

11.5 STOP NO. I. Outcrops in road cut above house and down lane to right. Highly fossiliferous Menard (Upper Mississippian) Limestone, underlain by Tar Springs Sandstone and overlain by Palestine Sandstone.

11.8 STOP NO. II. Keelin School. Kinkaid (uppermost Mississippian) shale and limestone exposed in north slope of the hill; cliff at bottom of hill shows vertical and shattered layers of sandstone, indicating proximity to a prominent fault. Hill above school house is capped by basal Pennsylvanian, Caseyville Sandstone.

12.3 <u>Caution</u> - Ford ~~Hogthief Creek.~~

STOP NO. IIA.
12.6 Roadside quarry at ford. St. Louis (Lower Mississippian) Limestone with distinct west dip. Some layers are full of reef-building corals. Chert nodules and calcite veins are conspicuous.

12.8 Pankey's Store, - 4 corners; turn right (E).

13.4 Country store near site of old Martha Furnace. Smelting of iron from local limonite ore began here in 1848 and continued for 9 years thereafter. Illinois Furnace, 2 miles west, operated for a much longer period and played an important part in early Illinois mineral industry.

13.7 <u>Caution</u>. Ford ~~Hogthief Creek.~~

13.8 STOP III. Quarry in St. Louis (Lower Mississippian) Limestone. Shows about 40 feet of strata with a westerly dip. Note same coral layer that was seen at STOP IIA. Calcite and small fluorspar veins present. Joint crevices show solution effects.

1_.9 Country store. Turn left (N).
For next 5 miles few exposures are seen, but route first passes over Lower Mississippian beds and then over successively higher formations of Upper Mississippian Age (see cross-section)

14.7 Caution. Ford.

15.5 Caution. Cross Gross road.

16.2 Caution. Ford.

16.3 Caution. Ford.

18.5 Junction with Cadiz-Karbers Ridge Road. Turn right (E) toward Cadiz.

19.2 STOP IV. Sparks Hill Volcanic Breccia. From road crest, go south past fluorspar test pit in woods, across small valley, over wooded knoll, to permanent stream flowing east. Out crop in creek at this point is 3/8 mile south of starting point.

Here masses of conglomerate-like rock appear to be debris from a volcanic explosion of great violence. Fragments embedded in the gray matrix include pieces of limestone, shale, sandstone, quartzite, granite, and other igneous and metamorphic rocks. These appear to have come from formations that lie, some of thousands of feet below the present surface. Layers of Mississippian Sandstone a few rods up and down the creek show no evident effects of this outburst.

In the test-pit, on the way to the breccia outcrop, specimens of zinc and lead ore (sphalerite and galena) may be collected. They occur along with the fluorspar atnumerous points in Hardin County.

19.3 Turn and reverse route.

20.1 Intersection of road from South; continue ahead.

20.4 Intersection of road from North; turn right (N).

21.6 Intersection at top of hill; turn right (E) on Pounds Hollow Road.

22.7 Junction on left, side road to the Pounds.. Turn left (N) on side road.

22.9 STOP V. "The Pounds". Deep chasms cut in basal Pennsylvanian, Caseyville Sandstone. Take trail to left, ascending hill and walk north 1/2 mile.

LUNCH STOP

23.1 Junction with main National Forest Road; turn left (E).

26.4 STOP. Junction with State Highway No. 1. Turn right (S) on No. 1.
From this point south to Cave in Rock, the highway passes over Pennsylvanian and Mississippian formations that have a distinct and regular dip to the north (see cross-section of eastern Hardin County). Going southward the road ascends the north slopes of the hills by long, gentle grades corresponding roughly to the dip-slope of the formations. The south hill slopes, on the other hand, are short and steep, where hard layers have been cut through by erosion. These steep slopes resulting

from the beveling of the exposed edges of formations are called "escarpments."

30.4 Cross Karbers Ridge Road.

30.7-9 Roadcuts in Caseyville (Pennsylvanian) Sandstone.

32.0 Roadcut showing beds of Tradewater Groups (Pennsylvanian); sandstone overlying shale.

35.2 Roadcut Hardinsburg Sandstone on Golconda Shale; both Upper Mississippian. Road makes steep descent down escarpment.

37.3 Roadcut in Rosiclare Sandstone (Lower Mississippian) forming escarpment.

37.6 Junction with State Highway No. 146. Turn right (W) on No. 146.

39.3 Turn right (N) on gravel road.

39.4 STOP VI. The Lower Chester (lower part of Upper Mississippian) escarpment rises about a mile north and is dotted with fluorspar mines. This same escarpment extends nearly 200 miles southeast through Kentucky, where it is called the Dripping Springs Escarpment. In the St. Genevieve and St. Louis Limestones below and at the foot of the escarpment, great caverns have developed, among them Mammoth Cave. Here between us and the escarpment, the rolling, pitted sink-hole topography can be seen. The large lake to the northeast may be present for years only to disappear suddenly, as its water escapes underground. When this underground drain becomes plugged with sediment and debris, the lake again comes into being.

40.8 STOP VII. Mine of the Crystal Fluorspar Co. Pope and Hardin Counties in Illinois and the adjoining part of Kentucky produce the bulk of U. S. fluorspar. Fluorspar is used principally as a flux in steel manufacturing, but fluorine enters into the manufacture of high-octane gasoline, refrigerants, plastics, insecticides. Fluorspar and compounds made from it are used in manufacturing glass, enamel, and aluminum.

Illinois fluorspar occurs either in veins along or close to fault zones, or in flat-lying blanket deposits. The latter near the top of the St. Genevieve Formation in a zone between the Rosiclare shale and sandstone above, and the Fredonia limestone below. The present mine exploits such a blanket deposit. Calcite as well as small quantities of galena (lead ore) and sphalerite (zinc ore) occur with the fluorite.

The fluorspar deposits are believed to have been formed when the region was undergoing the extensive fracturing, faulting, and folding for which it is famous. Warm solutions from deep in the earth and carrying mineral matter is solution deposited the minerals in crevices, as veins, or as a replacement of the Fredoni limestone in the blanket deposits. Elsewhere in Hardin County, molted lava-like rock oozed up in fractures and deposited "dikes" of greenish-black peridotite. This is the only igneous rock which comes to the surface in Illinois.

40.8 Rerverse route to highway.

42.3 Junction with State Highway No. 146; turn left (E) on No. 146.

44.0 Junction with State Highway No. 1; turn right (S) on No. 1.

45.9 Turn right (E) in Cave in Rock, onto road to State Park.

46.4 STOP VIII. Cave in Rock parking area. Take trail to the cave. This cave is a modest example of how underground water, moving along joint crevices, dissolves away some limestones to produce caverns. No cave deposits formed in this cave, probably because of its open proximity to the surface. The cave is developed in the St. Louis (Lower Mississippian) Limestone.

End of Conference - BON VOYAGE!

GENERALIZED GEOLOGIC COLUMN FOR EASTERN HARDIN COUNTY

Prepared by the Illinois State Geological Survey

ERAS		PERIODS	EPOCHS	FORMATIONS
Cenozoic "Recent Life" (Age of mammals)		Quaternary	Pleistocene	Alluvium and terrace deposits. No glacial drift in Hardin County
		Tertiary	Pliocene Miocene Oligocene Eocene Paleocene	Not present in Hardin County.
Mesozoic "Middle Life" (Age of Reptiles)		Cretaceous		Present in only the central portion of extreme southern Illinois.
		Jurassic		Not present in Illinois.
		Triassic		Not present in Illinois.
Paleozoic "Ancient Life"	Age of Amphibians and Early Plants	Permian		Not present in Illinois.
		Pennsylvanian	Pottsville	Tradewater formation and Caseyville conglomerate; largely sandstone and conglomerate.
		Mississippian	Chester (Upper Mississippian)	Series of alternating limestones, shales, and sandstones, variable in character.
			Iowa (Lower Mississippian)	St. Genevieve and St. Louis limestone best exposed in bluffs along the Ohio River.
	Age of Fishes	Devonian		Carbonaceous shale and Devonian limestone exposed only at Hicks Dome in western Hardin County.
	Age of Invertebrates	Silurian		Several hundred feet penetrated in deep well at Hicks Dome.
		Ordovician		Approximately 1500' penetrated in deep well at Hicks Dome.
		Cambrian		No data available.
Proterozoic Archeozoic		Referred to as "Pre-Cambrian" time.		No data available.

April, 1948 R.W.E.

GEOLOGIC HISTORY OF HARDIN COUNTY

DEEPLY BURIED FORMATIONS

The oldest bedrock which comes to the surface in Hardin County is Devonian in age and outcrops in the center of Hick's Dome, in the western part of the county. A deep oil test well, drilled on the dome in 1935 and deepened in 1944, penetrated to a depth of 3300 feet below the surface and passed through Devonian, Silurian, and Ordovician strata. There is no reason to doubt that, had it gone deeper, the boring would have encountered Cambrian strata below the Ordovician and eventually a Pre-Cambrian "basement complex" of igneous and metamorphic rocks.

EXPOSED FORMATIONS

All of the bedrock strata of the county originated as sediments in the later part of the Paleozoic Era. In the major portion of the area, rocks of Mississippian age outcrop or immediately underlie the loose surface material. The occurrence of older Devonian strata in the central portion of Hick's Dome has already been mentioned; the beds are limestone overlain by black carbonaceous shale.

Along the northern and eastern edges of the county, and also in some down-faulted "graben" areas, younger beds of Pennsylvanian (Coal Period) age are present above the Mississippian strata.

MISSISSIPPIAN SYSTEM

For convenience, in terms of the present conference, the Mississippian formations of Hardin County are separated into two divisions, the "Lower Mississippian," involving the Kinderhook, Osage, and Meramec groups, and the "Upper Mississippian," coinciding with the Chester Group. Of the "Lower Mississippian," we see only the two upper formations, the St. Louis and the St. Genevieve. These are both thick limestone formations which extend over many thousands of square miles in the Mississippi and Ohio Valleys. The overlying Chester Group, or "Upper Mississippian," is far more complex, and consists of an alternation of relatively thin formations of limestone, sandstone, and shale.

In the "Lower Mississippian" formations of Hardin County, all fossils found have been of marine origin, including large numbers of the coral *Lithostrotion canadense* in the St. Louis Limestone. In the Upper or Chester Division, marine fossils of great variety occur in the limestone formations whereas remains of land plants occur rarely in the sandstone formations. A thin coal seam is present in one of the Chester sandstones (Tar Springs Formation). The Upper Mississippian formations total more than 1000 feet in thickness in Hardin County.

PENNSYLVANIAN SYSTEM

A great thickness of Pennsylvanian strata once overlay the present surface of Hardin County, but erosion has since stripped it all away, except in limited areas, as mentioned above, where a part of this thick succession still remains. The most prominent Pennsylvanian group in Hardin County is the basal one, the Caseyville, consisting mainly of thick masses of sandstone, in places studded with white quartz pebbles. Less conspicuous in outcrop are beds of shale, and locally there is a 26-inch coal bed (Battery Rock Coal). The Caseyville Group reaches a thickness of 400 feet in Hardin County. Fossil ferns are sometimes found in some of the shale beds.

Above the Caseyville Group, in Hardin County, are limited areas underlain by strata of the Tradewater Group. These beds are not notably dissimilar to the Caseyville, except that there is a higher proportion of shale and quartz pebbles do not occur. The 300 feet of Tradewater beds present in the county include two thin coals and a six-inch limestone layer that contains marine fossils.

EARLY GEOLOGIC HISTORY

Between Pre-Cambrian Time, when the basement complex was formed and then worn down to a nearly level plain ("peneplain"), and the beginning of Upper Mississippian deposition, the area of Hardin County was much of the time, covered by the salt waters of shallow seas that invaded large areas of the North American Continent. At intervals when the seas withdrew, the region was generally a low coastal plain. No prominent amount of folding or fracturing took place during these hundreds of millions of years of geologic time.

With the beginning of Upper Mississippian (Chester) Time, the crust evidently became somewhat less stable, with alternate rising and sinking of the area to a moderate degree. This let in sea waters for relatively short periods. At other stages, fresh waters formed coastal lakes and lagoons. Under these conditions, sand and clays were deposited, which contained remains of land plants and which hardened to the present sandstones and shales.

In Pennsylvanian Time, in southern Illinois, the conditions just described became progressively more extreme, so that there are repeated successions of land, fresh water, and marine stages, with the marine element becoming much more limited than in the Upper Mississippian. Along the Atlantic Coast and to the South in Arkansas, Texas, and Oklahoma, mountains were beginning to rise. As erosion attacked these rising areas, great quantities of pebbles, sand and mud were washed into the Illinois basin. During stages when vast coastal swamps prevailed in the Pennsylvanian days, the rich coal fields of Illinois originated as thick masses of half decayed vegetation accumulated in the swamps.

DISTURBANCE OF EARTH'S CRUST

The strata of southeastern Illinois have suffered more disturbance than probably any other area in the Mississippi Valley. (This, of course, excludes disturbances before Cambrian Time.) This crustal disturbance resulted

in the formation of large, prominent folds and of an intricate system of faults. Within the area of the field trip, the most spectacular feature is the "graben" area extending NE-SW diagonally across the field trip area. A "graben" is a long narrow down-dropped segment of the earth's crust. The graben itself is fractured and broken by secondary faults (see cross-section). Probably at the same time, molten igneous magma from deep in the crust intruded the strata along crevices and solidified as greenish-black peridotite. More rarely, deep-seated explosions of gas or steam tore through the bedrock, fracturing it violently and blowing up fragments of other rocks from thousands of feet below the surface. One such occurrence is the Sparks Hill breccia seen on the trip. Hot liquids and gases, rising at the same time as the lavas, carried mineral solutions and deposited lead, zinc, and fluorspar in veins or in dissolved-out portions of the limestone layers.

The time of these disturbances is generally considered to have coincided with the elevation of the Appalachian Mountains in Permian Time, which followed the Pennsylvanian to close the Paleozoic Era.

LATER GEOLOGIC HISTORY

After the deposition of the Pennsylvanian strata in Hardin County, there is no evidence that seas ever again extended into this area, although in Cretaceous time the Gulf of Mexico reached as far north as southern Pope County. Evidently since Pennsylvanian Time, the region has existed as land area that has been undergoing erosion. At some stages, the streams wore the surface down to a nearly flat plain; then, when the whole region was uplifted some hundreds of feet, the streams again began to cut the country up into steep, more or less flat-topped, ridges and deep ravines and valleys, much as it appears today. This succession of stages of rugged and of nearly flat topography took place at least four times, according to R. D. Salisbury. At a level of about 600 feet above the sea lies the most extensive area of flat-topped hills in the region, which clearly represents an old plain of erosion (peneplain) that has since been cut up by later erosion.

ICE AGE HISTORY

Hardin County lies south of the limit of Pleistocene glaciation, but its surface suffered indirect changes due to the glacial conditions. Previous to the Ice Age, the Ohio River did not exist, but in its place were a number of short streams, most of which drained northward. Then the continental ice sheet advanced and halted just north of where the Ohio flows today. The prodigious amount of water resulting from the melting ice could not escape northward as previously because the streams there were blocked by the ice sheet. First they developed lakes in their headwaters, then the water spilled over from one dammed up valley to the next, and eventually the escaping waters cut their way through the divides, and the Ohio River came into being.